LISTING BACKGROUND DOCUMENT

WOOD PRESERVING

Wastewater from wood preserving processes that use creosote and/or pentachlorophenol (T)

Bottom sediment sludges from the treatment of wastewaters from wood preserving processes that use creosote and/or pentachlorophenol (T)

I. Summary of Basis for Listing*

Wood preserving processes that use creosote or pentachlorophenol as preserving agents generate a wastewater, which contains toxic phenolic compounds including penta- and tetrachlorophenol and polynuclear aromatic hydrocarbon (PAH) components of creosote. Treatment of this wastewater results in the generation of a number of bottom sediment sludges that must be removed for ultimate disposal. The Administrator has determined that wastewater from these wood preserving processes and the resulting bottom sediment sludges from wastewater treatment are solid wastes that may pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, disposed of or otherwise managed, and therefore should be subject to appropriate management requirements under Subtitle C of RCRA.

*Based on available data, and in response to industry comment on the proposed listing (44 FR 49403, August 22, 1979), the Agency has modified this listing. Waste streams from wood preserving processes using waterborne inorganic preservatives are not included in the listings of this document. However, the Agency plans to study the sludges generated from these wood preserving processes (i.e., from work tanks, cyclinders or storage tanks), to determine whether they should also be listed. In addition, the Agency intends to study sludges generated from the periodic dredging of retorts, cyclinders, and holding tanks in which pentachlorophenol and creosote are used in the future to determine whether these sludges also should be listed.

This conclusion is based on the following considerations:

1) The wastewater generated from wood preserving processes using pentachlorophenol as a preservative and the sludge generated from the treatment of this wastewater will contain significant concentrations of phenolic compounds. The wastewater from wood preserving processes that use creosote and the sludges generated from the treatment of this wastewater will contain significant concentrations of polynuclear aromatic components of creosote. Wastewater and the resulting sludges from wood preserving operations that use both creosote and pentachlorophenol as preservatives will generate waste streams which contain all or most of the above contaminants.

2) Polynuclear aromatics, as a group, are known to be toxic, mutagenic, teratogenic and carcinogenic. Phenolics are toxic and, in some cases, bioaccumulative and carcinogenic.

3) Approximately 200,000,000 gallons of wastewater are generated annually from wood preserving processes using pentachlorophenol and creosote. About 90 percent of this wastewater is treated by treatment methods which generate a bottom sediment sludge. The large quantity of waste generated increases the opportunity for exposure if waste mismanagement occurs.

4) Treatment of wastewater in evaporation ponds or lagoons could lead to the environmental release of hazardous constituents and result in substantial hazard via groundwater or surface water exposure pathways. Evaporation of wastewater in ponds, lagoons or by other treatment methods such as spray irrigation, if mismanaged, could also lead to the release of hazardous constituents into the atmosphere and result in substantial hazard via an air exposure pathway.

5) The Agency has also been informed that incineration is another (though less frequently used) disposal method for these sludges. If improperly managed, incineration could result in the release of hazardous vapors to the atmosphere, presenting a substantial hazard via an air exposure pathway.

6) Off-site disposal in landfills is the most commonly used disposal method for these sludges. This presents the possibility of the toxic components in the sludge migrating to nearby underground drinking water sources if the landfill is improperly designed or operated.

7) Several incidents of mismanagement of wood preserving plant wastes have occurred, demonstrating empirically that these wastes are capable of causing substantial harm if mismanaged.

II. Sources of the Wastes and Typical Disposal Practices

A. Industry Profile and Manufacturing Process

There are more than 415 wood preserving plants operated by about 300 companies in the United States. The plants are concentrated in two areas, the Southeast from east Texas to Maryland, and along the North Pacific coast. These areas correspond to the natural ranges of the southern pine and Douglas fir-western red cedar, respectively (2).

Approximately 250 million cubic feet of wood are treated each year (1), principally for railroad ties, utility poles, and lumber for construction materials. It is estimated that approximately 85 percent is treated with creosote or pentachlorophenol based preservatives as shown in Table 1 (4). The total quantity of preservative consumed in 1975 during these treatment cycles is shown in Table 2.

B. Process Description

At plants using creosote or pentachlorophenol-based preservatives, wood products are treated to increase their resistance to natural decay, attack by insects, micro-organisms,

TABLE 1

ESTIMATED PRODUCTION OF TREATED WOOD, 1978 (43)

Products	Treated With			
	All Preservatives[b]	Creosote Solutions	Penta	CCA/ACA/FCAP*
	1,000 cu. ft.			
Crossties and switchties[c]	106,085	103,138	449	2,498
Poles	64,179	18,237	41,905	4,038
Crossarms	1,685	41.0	1,615	29.1
Piling	12,090	9,993	1,154	943
Lumber and timbers	105,305	10,779	21,209	73,317
Fence posts	20,028	4,584	10,983	4,461
Other products[d]	18,113	7,815	2,681	7,616
All products	327,485	154,587	79,996	92,903

*CCA: chromated copper arsenate, ACA: ammoniacal copper arsenate, FCAP: fluor-chrome-arsenate phenol

[a] Volume reported for 1977 (AWAP), plus volume reported by respondents to Assessment Team Survey, plus volume estimated for nonrespondents.

[b] Creosote, Penta, and CCA/ACA/FCAP only.

[c] Includes landscape ties.

[d] Includes plywood.

Note: Components may not add to totals due to rounding.

TABLE 2

QUANTITY OF PRESERVATIVES USED IN 1978. (44)

Preservative	Quantity(million lbs/year)
Creosote & petrolatum	178.2
Creosote and coal tar	910
Pentachlorophenol (solid, solution)	40.8
Inorganic Arsenic salts	37.2

or fire. Briefly, the treatment consists of debarking, forming, drying, impregnation of preservative, and storage (3).

The two major wood preserving processes, producing large quantities of wastewater and sediment sludge, are called steaming and boultonizing.* Both of these processes are pressure processes and differ mainly in the way the wood is conditioned before or during the application of the preservative. Figures 1a-1e present flow diagrams for the major wood preserving processes (Source: Reference 19).

Steaming is used principally on southern pines. In this process, the stock is normally steamed for 1 to 16 hours at about 120°C to reduce the wood's moisture content and render it more penetrable to preservatives. After steaming, the preservative is added to the same retort. Condensate removed from the retort after steaming is contaminated with entrained oils, organic compounds, and wood carbohydrates.

In the Boulton process, used principally on Western Douglas fir, the wood is immersed in the preservative, placed under vacuum, and then heated in the retort at approximately 100°C. The vapor removed is composed of water, oils, organic compounds and carbohydrates from the wood. Contaminated vapors from both the steaming and boultonizing processes are

*Vapor drying is another wood preserving process, also generating a wastewater and sludge of concern.

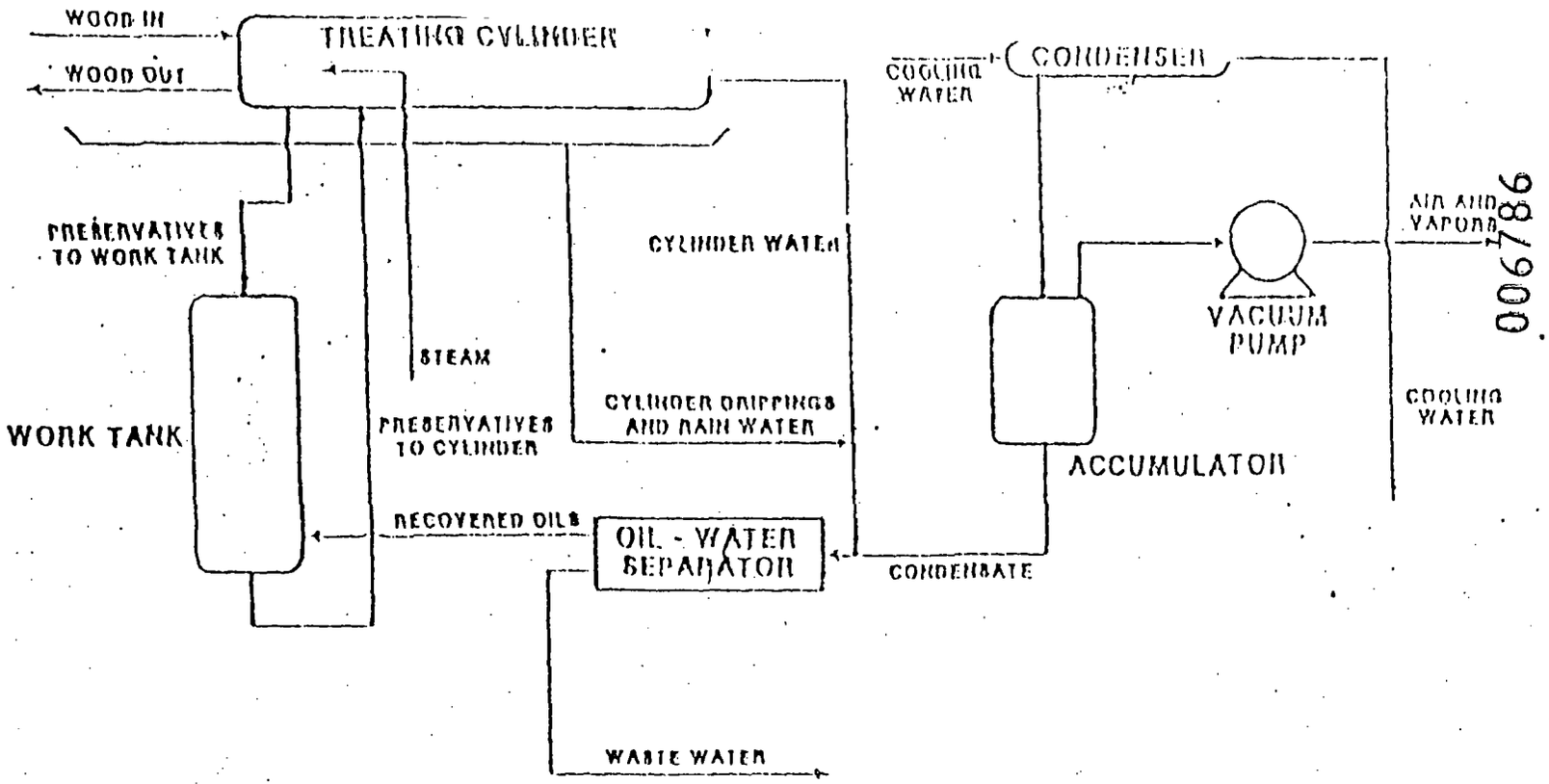


Figure 1a - OPEN STEAMING PROCESS WOOD TREATING PLANT

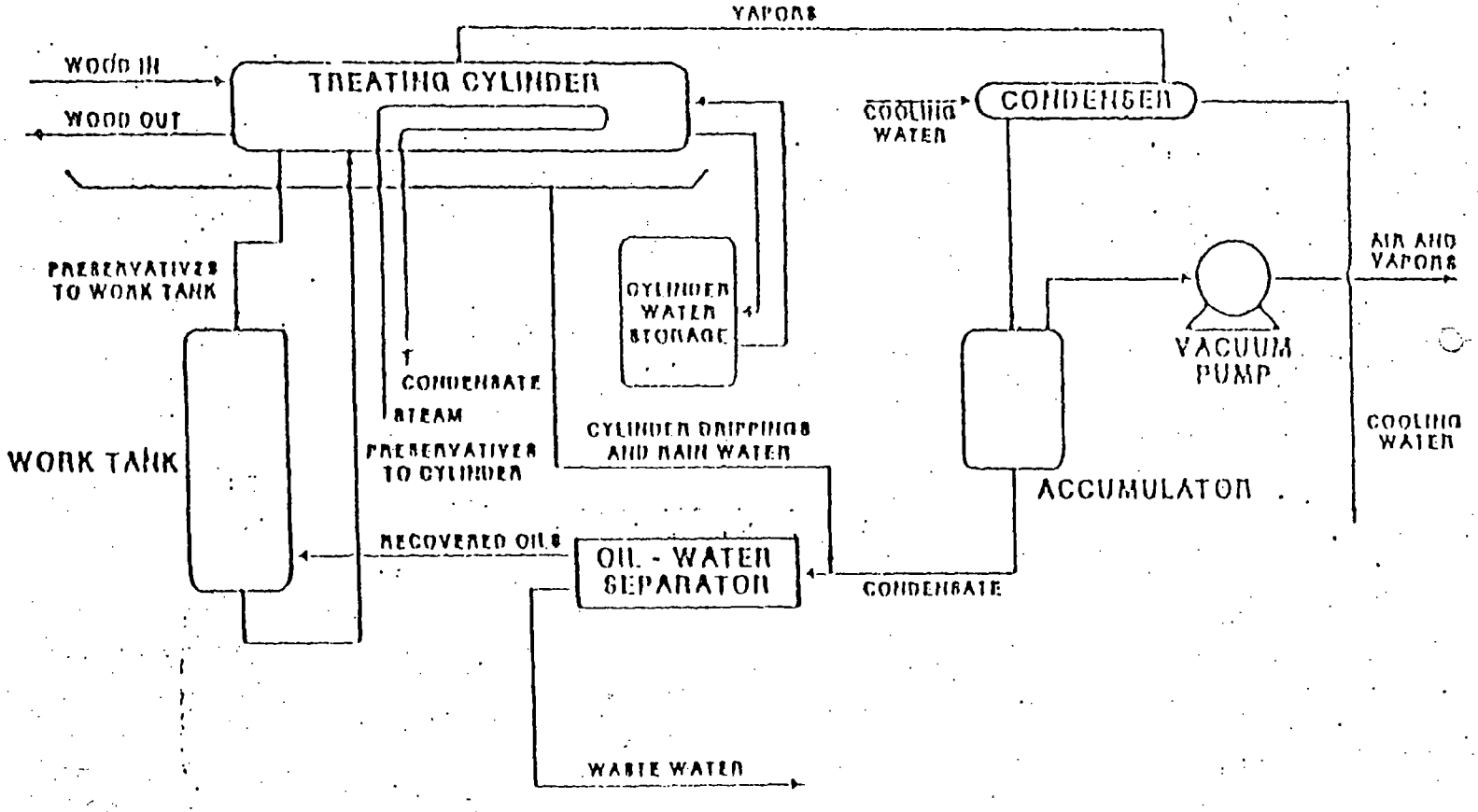
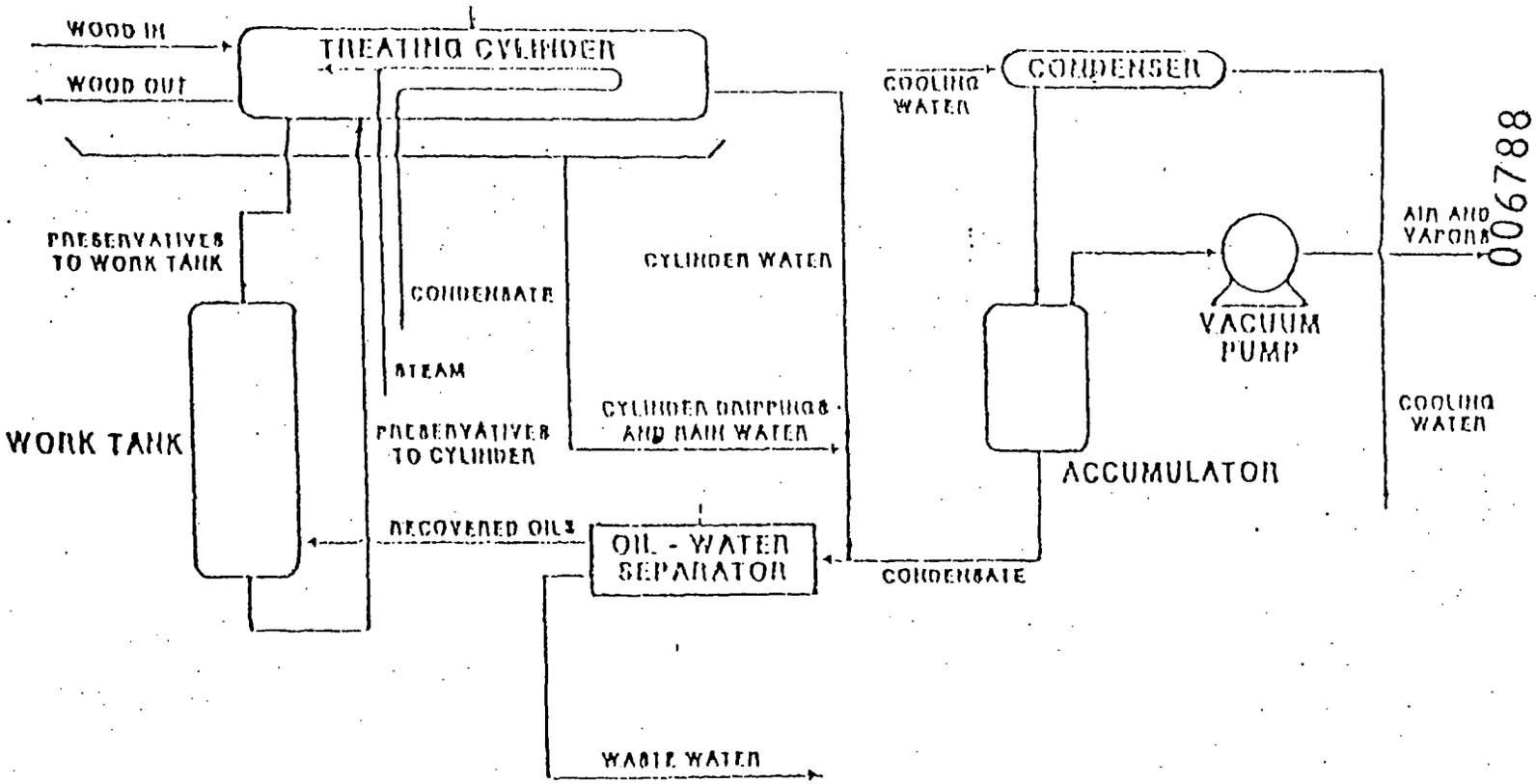


Figure 1b. CLOSED STEAMING PROCESS WOOD TREATING PLANT



006788

Figure 1c . MODIFIED STEAMING PROCESS WOOD TREATING PLANT

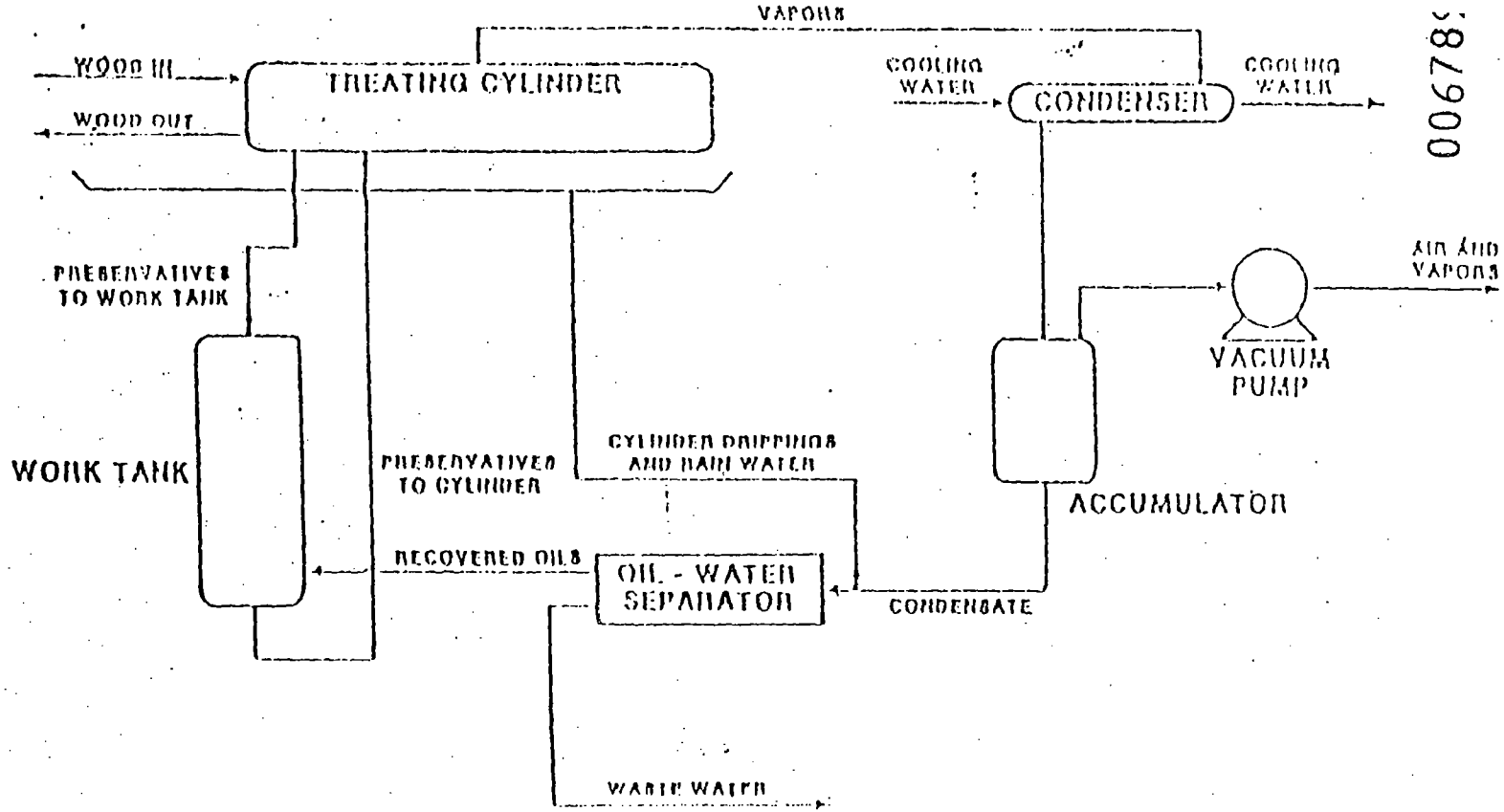
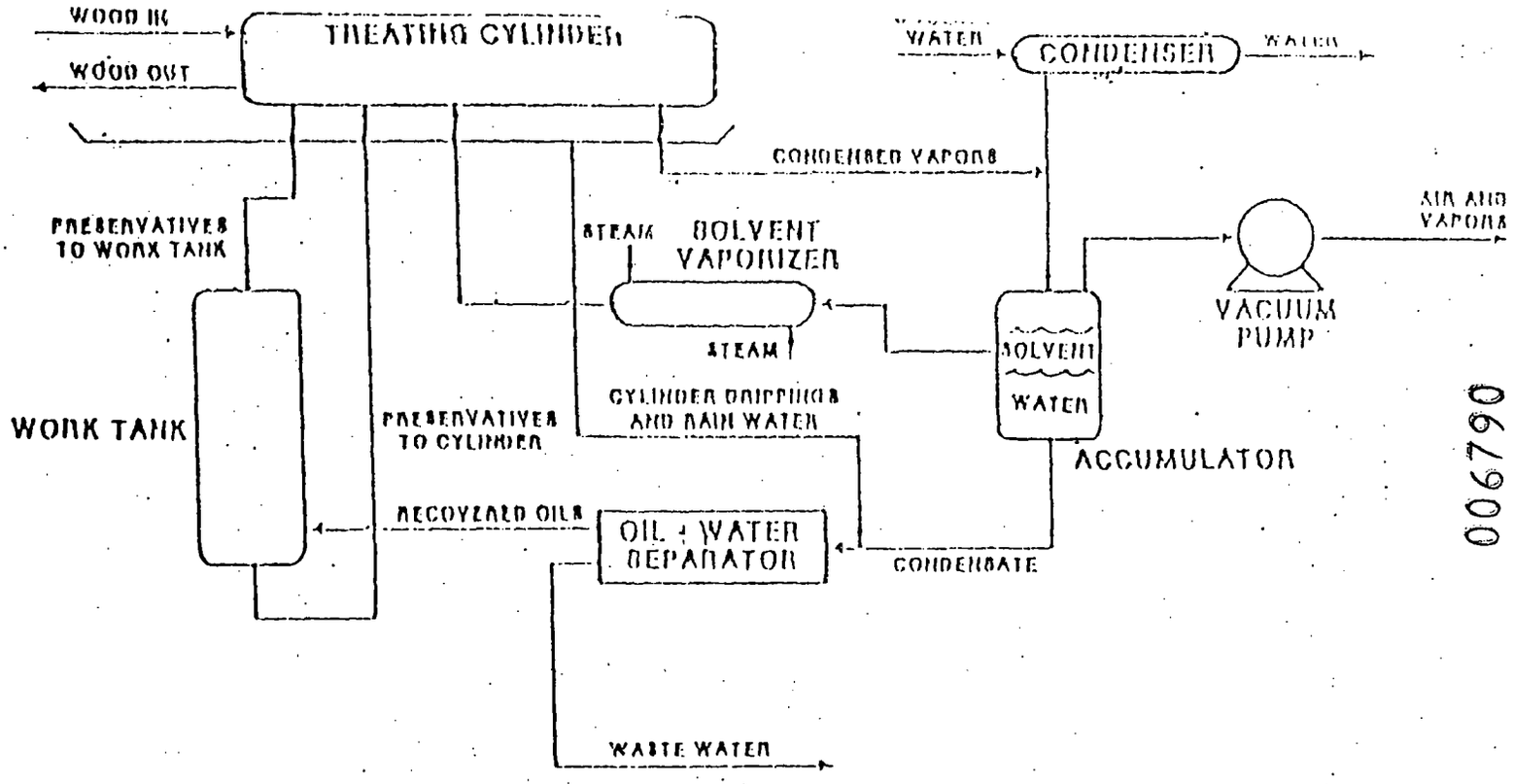


Figure 1d BOULTON WOOD TREATING PLANT



006790

Figure 1c VAPOR CONDITIONING PROCESS WOOD TREATING PLANT

condensed and transported to an oil/water separator to reclaim any free oils and preserving chemicals before treatment and/or disposal of the wastewater.(17,18)

C. Generation, Composition, and Management of Listed Waste Streams (17,18)

1. Industry Generation of Waste

Based on the quantity of wood treated with creosote or pentachlorophenol preservatives in 1975, and assuming that about one gallon of wastewater is generated per cubic foot of wood treated, over 200 million gallons of wastewater will be generated annually.

Almost all of this wastewater is treated by treatment methods that generate a bottom sediment sludge. Over 300,000 gallons per day of wastewater is discharged to POTW's. The listing covers both of these instances.*

Table 3 shows estimates of the amounts of wastewater treatment sludges generated by creosote and pentachlorophenol preserving processes, and the amount of certain of the hazardous constituents contained in the wastes.

---

*The listing does not include wastewater discharged from a point source regulated under §402 of CWA. This listing also does not include any wastewater which is mixed with domestic sewage and that passes through a sewer system before it reaches a publicly owned treatment works (POTW). "Domestic Sewage" means untreated sanitary wastes that pass through a sewer system, (See §261.4(a)(1)(i) and (ii)).

TABLE 3. POTENTIALLY HAZARDOUS SOLID WASTES FROM THE WOOD PRESERVING INDUSTRY (8)*

(Source: American Wood Preserver's Association (1979))

Total Process Solid Waste metric tons/yr	Total Potentially Hazardous Constituents metric tons/yr
Creosote-oil emulsion 230-930	Creosote 1.1-4.6
Penta-oil emulsion 600*	Pentachlorophenol 3.0

Note: Although these wastes are listed in the table in terms of amounts generated per year, many of the wastes are generated on a periodic basis which often can be as long as five years (8). Thus, the sludges may be allowed to sit at the bottom of wastewater treatment ponds for five years at a time. Sometimes the bottom sediment sludges from the biological treatment of wood preserving wastewater are never removed.

*Estimated maximum amount.

2. Composition

The organic components of the wastewater and bottom sediment sludges from the wood preserving industry results from the different constituents in the different formulations of pentchlorophenol and creosote and decomposition products of the constituents of the preservatives.

Table 4 gives typical compositions of commercial grade pentachlorophenol.(35) The amount of chlorinated dibenzo-p-dioxins and furans varies with each industrial batch, even when produced by the same manufacturer. In addition to the constituents present in commercial pentachlorophenol, other phenolic compounds have been found in wood preserving sludges and wastewater, such as unsubstituted phenol (Table 6); 2,4-dimethylphenol; p-chloro-m-cresol; 2-chlorophenol; 2,4-dichlorophenol; and 2,4-dinitrophenol (Table 7). These additional phenolic compounds may be the result of decomposition of the commercial pentachlorophenol.

The consitutents of creosote are highly variable, depending on the source of the coal, the design and attendant operating conditions of the coke ovens and still, and the blending of various tar distillate fractions.(37) Several hundred constituents have been identified, with between 11-22 percent in concentrations greater than 1%.(36) (Table 5). Benzo[a]pyrene is present at 200 ppm.(38) (The presence of benzo[a]pyrene as a constituent in creosote is further

TABLE 4

COMPOSITION OF SOME COMMERCIAL PENTACHLOROPHENOL SAMPLES.(35)

	Dowicide EC-7	Dowicide 7	Monsanto
Pentachlorophenol	90.4 ± 1.0%	85-90%	84.6%
Tetrachlorophenol	10.4 ± 0.2%	4-8%	3%
Trichlorophenol	< 0.1%	< 0.1%	
Higher Chlorophenols		2-6%	
Caustic Insolubles (max)		1	
2,3,7,8-Tetrachlorodibenzo-p dioxins	< 0.05 ppm	----	< 0.1 ppm
Pentachlorodibenzo-p-dioxins			< 0.1
Hexachlorodibenzo-p-dioxins	1.0 ± 0.1 ppm	9.27 ppm	8 (5) p
Heptachlorodibenzo-p-dioxins	6.5 ± 1.0 ppm	----	520 ppm
Octachlorodibenzo-p-dioxins	15.0 ± 3.0 ppm	575-2510 ppm	1380 ppm
Tetrachlorodibenzofurans			< 4 ppm
Pentachlorodibenzofurans			40 ppm
Hexachlorodibenzofurans	3.4 ± 0.4 ppm	Detected	90 ppm
Heptachlorodibenzofurans	1.8 ± 0.3 ppm	Detected	400 ppm
Octachlorodibenzofuran	< 1 ppm	Detected	260 ppm

TABLE 5

CONSTITUENTS OF CREOSOTE

MAJOR COMPONENTS REPORTED PRESENT IN WHOLE CREOSOTE (REF.36)

Naphthalene
2-Methylnaphthalene
1-Methylnaphthalene
Biphenyl
Dimethylnaphthalenes
Acenaphthene
Dibenzofuran
Fluorene
9,10-Dihydroanthracene
Methylfluorene
Phenanthrene
Anthracene
Acridine
Carbazol
Methylphenanthrenes
2-Phenylnaphthalene
Methylanthracenes
Pyrene
Benzofluorenes
Chrysene
9,10-Benzophenanthrene

HAZARDOUS COMPONENTS PRESENT IN SMALL QUANTITIES (less than 1%)

IN CREOSOTE (Ref. 40, 41, 42)

Benzo[a]pyrene
Benz[a]anthracene
Benzo[b]fluoranthene
Dibenz[a,h]anthracene
Indeno[1,2,3-cd]pyrene

confirmed by the detection of elevated levels of benzo[a] pyrene is mussles growing near creosote treated timber pilings (about 50 ug/kg; 20 times background).[39,40]) Other hazardous components of creosote in concentrations less than 1% are included in Table 5 based on their detection in edible meat of lobsters maintained in commercial tidal compounds constructed of creosote treated timber[40,41], their detection in other coal tar fractions,[42] and in part their presence in some wood preserving sludges where creosote is used (Table 8). The constituents normally occuring in coal tar are expected to be in the wastes of this industry, since creosote-coal tar solutions are used more frequently than creosote-petroleum solutions (Table 2).

Table 6 lists of some of the typical organic compounds found in wood treating plant wastewaters.* The absence in this Table of certain components of the original wood preservative chemicals, particularly some of the different phenolic compounds, probably indicates that an analysis for their presence was not performed rather than an actual absence of the component.

*Approximately 125 wood preserving plants use both organic and inorganic preservatives. Although the systems are kept separate, cross contamination of chemicals may occur through exchange of dollies used to transport the wood and drippage from the inorganic into the organic operation. Thus, wastewater from organic wood treatment processes often contains inorganic materials.

TABLE 6. ORGANIC COMPOUNDS FOUND IN WOOD PRESERVING PLANT WASTEWATER.(18)*

Analysis of toxic phenolic compounds from 20 steam processing plants.

	Concentration (mg/l)		
	Average	High	Low
phenol	158.0	501.3	1.0
pentachlorophenol	55.0	306.0	1.2
total oil and grease	793.8	1,902.	11.0

Analysis of toxic phenolic compounds from 5 Boulton conditioning plants.

phenol	491.4	1272.0	0.9
pentachlorophenol	10.9	27.0	0.01
total oil and grease	321.5	1357.	12.3

Analysis of toxic polynuclear aromatic hydrocarbons from 9 steam conditioning plants.

fluoranthene	4.1	35.0	0.63
benzo[b]fluoranthene	0.69	1.68	0.03
benzo[a]pyrene	1.12	2.70	0.007
indeno [1,2,3-cd]pyrene	2.0	5.50	0.006
benz[a]anthracene	1.53	7.70	0.07
dibenz[a,h]anthracene	0.43	0.43	--
naphthalene	10.5	45.0	0.38
acenaphtylene	0.79	1.21	0.006
chrysene	0.48	4.70	0.07
total PAH's	39.89	232.86	7.90

Analysis of toxic polynuclear aromatic hydrocarbons from one Boulton conditioning plant using creosote

fluoranthene	0.282
benzo[b]fluoranthene	--
benzo[a]pyrene	--
indeno[1,2,3-cd]pyrene	--
benz[a]anthracene	0.034
dibenz[a,h]anthracene	--
naphthalene	3.14
acenaphthylene	2.06
chrysene	0.018
total PAH's	8.167

*Other relevant data for comparing these concentrations such as total daily wastewater flow and daily production volume may be found in the cited reference.

006797

Table 7 lists toxic organic compounds which have been found in the various wood preserving wastewater treatment sludges, such as the bottom of primary oil/water separater treatment sludges, flocculation sediment sludges, and biological treatment sludges.[17,26] These contain the constituents of the wood preservatives and decomposition products. The analyses of the wood treating plant sludges did not reveal every constituent listed in Table 6 in every sludge. However, pentachlorophenol and polynuclear aromatic hydrocarbons were common to all sludges tested.

Many wood processing plants, such as the two listed below, may use both creosote and pentachlorophenol based processes and thus treat the wastewater generated by these processes in a combined treatment system. Thus, sludge samples from one plant may contain both creosote compounds and phenolic compounds.[6]

According to data taken from California State hazardous waste manifests[7], one bottom sediment sludge from a wood preserving plant was found to contain 5-20% pentachlorophenol.

3. Disposal and Waste Treatment Practices

These plants typically send their wastewater to a series of treatment processes, which often generate bottom sediment sludges. The wastewater then is either completely retained and disposed of on the facility site (i.e., by evaporation, spray irrigation, etc.) or discharged to publicly owned treatment works, or navigable waterways. The wastewater

TABLE 7. TOXIC ORGANIC COMPOUNDS FOUND IN VARIOUS WOOD PRESERVING PLANT WASTEWATER TREATMENT SLUDGES (17,26)

Polynuclear Aromatic Hydrocarbons:
Fluoranthene
Benzo(b)fluoranthene
Benzo(a)pyrene
Indeno(1,2,3-cd)pyrene
Benzo(a)anthracene
Dibenzo(a,h)anthracene
Acenaphthene
Naphthalene
Chrysene
Phenolics

Phenol	2,4-Dichlorophenol
2-Chlorophenol	2,4-Dinitrophenol
Pentachlorophenol	p-Chloro-m-cresol
2,4-dimethylphenol	2,4,6-Trichlorophe

is first generated at primary oil/water separation. The wastewater treatment sludges are generated first at oil/water primary separation and in subsequent treatment steps.

The initial wastewater treatment at most facilities is a primary oil-water separation, where much of the wood treatment chemicals are recovered and recycled to the preservative work tank. Variations include the addition of secondary oil water separators, accumulation or surge tanks prior to the oil water separators, or dehydrators for the oil recovered from the separators. These wastewater treatment processes each generate sludges which are periodically removed, containing the components of creosote and/or pentachlorophenol. An analysis of the sludge from the bottom of a pentachlorophenol oil-water separation pit showed concentrations of 1.84 ppm pentachlorophenol; 1,650 ppm 2,4-dichlorophenol; 5,090 ppm fluoranthene; 43,640 ppm naphthalene; 604 ppm pyrene; 8,410 ppm anthracene/phenanthrene; and 1,690 ppm p-chloro-m-cresol.*(26)

Flocculation or adsorption of the wood preserving oils by the addition of clays, resins, alum, lime, or polymers is sometimes used as a secondary wastewater treatment process after primary oil-water separation. This process also generates bottom sediment sludges with a high oil and pentachlorophenol content. An analysis of the sludge from treating pentachloro-

*These analytical values should be used only to indicate ranges of concentrations. The Agency has not yet established standard protocols for these analyses

phenol wastewater with polymeric flocculants and clay after two oil separation steps showed concentrations of 8.2 ppm 2,4-dimethylphenol; 1,400 ppm fluoranthene; 3,000 ppm acenaphthene; 1,200 ppm naphthalene; 52 ppm pyrene; 45 ppm chrysene; 84 ppm benzo[ghi]perylene; 1,400 ppm fluorene; 52 ppm dibenz[ah] anthracene; and 3,200 ppm phenanthrene.*(26).

Biological treatment of pre-processed wastewaters is used at some facilities. Alternatively, the pretreated wastewaters are sometimes discharged to publicly owned treatment works (POTWs) which use some form of biological treatment process.

Two plants using biological aerated lagoons as one step in their wastewater treatment process were found to have compounds from both creosote and pentachlorophenol as constituents of their sludges (Table 8). The wastewater treatment system for the first plant (Plant 10) generally consists of: (1) chemical flocculation with Bentonite clay and decantation, leaving a clay sludge, (2) nutrient addition and aeration of the clarified wastewater, generating a biological sludge, (3) spray pond evaporation, and (4) total retention of the wastewater by evaporation from the retention pond. The wastewater treatment system for the second plant (Plant 11) consists of: (1) settling in a basin where collected oil is recycled, (2) storage for 40 days in a pond and recycling of the water to the plant, (3) lagoon aeration with 60 days detention time, (4) spray irrigation, and (5) runoff storage.

*These analytical values should be used only to indicate ranges of concentrations. The Agency has not yet established standards protocols for these analyses.

TABLE 8. ORGANIC COMPOUNDS FOUND IN SLUDGES FROM AERATED LAGOON SECTIONS OF WASTEWATER TREATMENT FACILITIES (Ref. 6)

Plant 10

	Bottom Sediment Dry Weight (ug/kg)(6)	
Polynuclear Aromatic Hydrocarbons	Aerated Lagoon	Final Pond
Benz[a]anthracene*	3,700	149
Chrysene*	4,500	2,060
Phenolics		
Phenol	9,030	16,000
2,4-dimethylphenol	4,398	3,418
2-chlorophenol	396,000	1,200
2,4,6-trichlorophenol	No data	25,000
Pentachlorophenol	302,000	58,000

Plant 11

	Bottom Sediment Dry Weight (ug/kg)(6)
Polynuclear Aromatics	Aerated Lagoon
Benz[a]anthracene*	1,250
Benzo[a]pyrene*	5,980
Chrysene*	9,280
Phenolics	
Phenol	4,500
2-chlorophenol	300
Pentachlorophenol	4,800

*These were the only polynuclear aromatic hydrocarbons tested for. These components are known to be present in creosote in relatively small concentrations, so that a much higher total polynuclear aromatic hydrocarbon concentration could be inferred. In any case, these concentrations of these constituents are significant in light of their carcinogenicity. See Table 10, showing carcinogenic risk from exposure to these components at concentrations orders of magnitude lower than those observed at Plant 11.

After biological treatment, treatment by irrigation may be used. This process typically consists of (1) settling, (2) storage, (3) aerated treatment, (4) spray irrigation, and (5) runoff storage as described for Plant 11 above. The wastewater flow at this particular plant equipped with this type of treatment system averaged approximately 50,000 gallons a day.(6)

It has been argued that many of the hazardous constituents in wastewater are biodegradable and therefore would not be found in wastewater treatment sludges resulting from biological treatment. This argument first of all does not apply when sludges are generated by non-biological treatment. Information available to the Agency indicates that a large percentage of wood treating plants practice either flocculation and/or sand filtration as well as primary oil/water separation treatment steps prior to biological treatment.(19) In any case, the Agency continues to believe that most biological treatment sludges still will contain significant concentrations of toxic phenols and in some instances significant concentrations of the constituents of creosote, since the mechanism of reduction of pentachlorophenol and high molecular weight toxic pollutants is thought to be that of adsorption upon the biomass rather than complete biological degradation.(19)*

*Some comments were received stating that a hazardous waste designation would discourage biological treatment of wastewater. Where biological treatment, in fact, proves successful in adequately degrading hazardous constituents, the delisting mechanism provides generators a means of avoiding hazardous waste status for their treatment sludges.

Studies on biodegradability indicate that under specific idealized conditions, pentachlorophenol is biodegradable (9,10,11). Pentachlorophenol has been shown to be degradable when composted in permeable soil at pentachlorophenol concentrations of 200 ppm or less. Under these conditions, at least 98% of the PCP can be destroyed in about 200 days (12). However, biodegradation is feasible only if the microorganisms have been acclimated to pentachlorophenol and the pentachlorophenol concentration is carefully controlled (13). Another study found that PCP persisted in warm moist soils for a period of 12 months (22). The sludge, therefore, would need to be combined with non-contaminated permeable soil in a ratio of 1:20 in order to ensure that the reported level of degradation at the disposal site is possible.

The viability for activated sludge to be used as a treatment for wastewater from the wood preserving industry containing pentachlorophenol indeed was questioned by one study.(33) Initially, the acclimated biomass would remove large quantities of pentachlorophenol, resulting in effluent concentrations of less than 1.0 mg/liter. However, in all cases, a point was reached where additional pentachlorophenol was not removed. Decreasing the pentachlorophenol concentrations in the influent to the bioreactor feed tended only to postpone when the sludge became saturated. Therefore, biodegradation of pentachlorophenol under the conditions of this system did not appear to be occuring.

Furthermore, Table 8 gives sludge sample data taken at two plants which treated wastewater with biological processes and shows that phenols and polynculear aromatic hydrocarbons are not completing biodegraded.

Additionally, a contractor/hauler that disposes of an unspecified bottom sediment sludge for a wood treatment plant has provided an analysis of the waste for EPA (3). The analysis is as follows:

Component	Concentration, mg/l[6]
Total phenols	5,043
Pentachlorophenol	34
Dinitrophenol	24
Creosote	10,000

Evaporation with or without the addition of heat is another process used to treat wastewaters and which generates bottom sediment sludges. Incineration of wastewaters is another less frequently practiced treatment process for the wastewaters. Discharge to the air of decomposition products of pentachlorophenol, such as chlorinated dioxins and dibenzofurans, [23,24,25] as well as the volatilized organic constituents pentachlorophenol and creosote, is possible under uncontrolled situations.

III. Discussion of Basis for Listing

A. Hazardous Properties of the Waste

As discussed earlier, the most commonly used wood preservatives are creosote and pentachlorophenol. The principal toxic pollutants in wastewater from plants that use these preservatives are phenolic compounds, and polynuclear aromatic

hydrocarbon components of creosote. Table 10 summarizes the concentrations of these substances in ambient water which have been found toxic to aquatic life or necessary to protect human health by the Agency's Office of Water Regulation and Standards.(34) Comparison of these ambient water criteria with the concentrations of the pollutants found in the wood preserving industry's wastewater and wastewater treatment sludges (Tables 6-9) clearly indicates the potential for environmental damage or harm to human health if these wastes are mismanaged, since the observed concentrations are many orders of magnitude above ambient water quality criteria levels for protection of potential adverse effects on human health.

The World Health Organization 1970 Standards for Drinking Water recommends a concentration of PAHs not to exceed 0.2 ug/l. This value is greater than the ambient water quality criteria given in Table 10, but is substantially less than the concentrations found in plant effluents (Table 6).

EPA's Office of Water and Waste Management, Effluent Guidelines Division has set a maximum limit of 100 mg/l oil and grease for point source effluents from the wood preserving industry, based on considerations of technology and economic feasibility. (See 40 CFR §§429.74 and 429.84.) This 100 mg/l oil and grease level has been found to correspond to an approximate 1.0 mg/l polynuclear aromatic hydrocarbon effluent concentration and an approximate 15 mg/l pentachlorophenol

TABLE 10

AMBIENT WATER QUALITY CRITERIA & OBSERVED TOXICITY LEVELS FOR CONTAMINANTS PRESENT OR LIKELY TO BE PRESENT IN THESE WASTES** (Ref. 34)

mg/l = milligrams per liter = ppm = parts per million
ug/l = micrograms per liter = ppb = parts per billion
ng/l = nanograms per liter = ppt = parts per trillion

	Freshwater Aquatic Life	Saltwater Aquatic Life	Human Health
POLYNUCLEAR AROMATIC HYDROCARBONS (PAHs)			
PAHs (total)	--	300 ug/l (acute)	2.8 ng/l* (cancer risk of 10^{-6})
Acenaphthene	520 ug/l (acute)	500 ug/l (acute)	.02 mg/l (taste and od only)
Fluoranthene	3980 ug/l (acute	16 ug/l (acute)	42 ug/l
Isophorone	117,000 ug/l (acute)	12,900 ug/l (acute)	5.2 mg/l
Naphthalene	620 ug/l	2,350 ug/l (acute)	insufficient data
Benzo[a]pyrene	--	--	2.8 ng/l* (cancer risk of 10^{-6})
Dibenz[a,h]anthracene	--	--	1.3 ng/l*

*Indicates recommended criteria level to protect human health or aquatic organisms. The cancer risk hazards given in this table are for protection at the one 10^6 level. The Ambient Water Quality Criteria give ranges for protection from cancer risks from 0 corresponding to zero exposure level up to 10^5.

**Lowest toxicity values are cited. No entry indicates insufficient data to establish a level for either acute or chronic toxicity. See original documents for more information.

006807

	Freshwater Aquatic Life	Saltwater Aquatic Life	(cancer risk of 10^{-6}) Human Health
PHENOLIC COMPOUNDS			
Phenol	2,560 ug/l (acute & chronic)	5,800 ug/l (acute)	3.5 mg/1* (toxicity)
			0.3 mg/1 * (taste & odor
2-Chlorophenol	4,380 ug/l (acute)	--	0/1 ug/1* (taste & odor)
	2,000 ug/l (flavor, fish)		
3-Chlorophenol			0.1 ug/1* (taste and od
4-Chlorophenol	--	29,700 ug/l (acute)	0.1 ug/1* (taste & odor)
2,3-Dichlorophenol	--	--	0.4 ug/1* (taste & odor)
2,4-Dichlorophenol	365 ug/l (chronic)	--	3.09 mg/1* (toxicity)
	0.4 ug/1 (flavor, fish)		0.3 ug/1* (taste & odor)
2,5-Dichlorophenol	--	--	0.5 ug/1* (taste & odor)
2,6-Dichlorophenol	--	--	0.2 ug/1* (taste & odor)
3,4-Dichlorophenol			0.3 ug/1* (taste & odor)
2,4,5-Trichlorophenol	--	--	2,600 ug/1* (toxicity)
			1.0 ug/1* (taste & odor)
2,4,6-Trichlorophenol	970 ug/l	--	1.2 ug/1* (cancer risk o 10^{-6})

	Freshwater Aquatic Life	Saltwater Aquatic Life	Human Health
2,3,4,6-Tetrachlorophenol	--	--	1.0 ug/l* (taste & odor)
2,3,5,6-Tetrachlorophenol	--	400 ug/l (acute)	1.0 mg/l (toxicity)
			30 ug/l* (taste & odor)
2-Methyl-4-chlorophenol	--	--	1800 ug/l* (taste & odor)
3-Methly-4-chlorophenol	30 ug/l (acute)	--	3000 ug/l* (taste & odor)
3-Methyl-6-chlorophenol	--	--	20 ug/l* (taste & odor)
Nitrophenols (general)	150 ug/l (acute)	4,850 ug/l (acute)	--
Dinitro-o-cresol	--	--	13.4 ug/l* (toxicity)
Dinitrophenol	--	--	70 ug/l* (toxicity)

concentration. Actual risk assesment calculations for protecting the health of specific population groups were not used to calculate this standard. Even so, Table 5 shows that wastewater from this industry after primary treatment by oil/water separation contains higher concentrations of oil and grease than allowed by this standard and also higher concentrations of polynuclear aromatic hydrocarbons and phenolics than if the 100 mg/l oil and grease criteria were met. Further, the concentrations of polynuclear aromatic hydrocarbons and phenolics that correspond to 100 mg/l oil and grease are much higher than the ambient water quality criteria given in Table 10.

Phenolics are toxic and in some cases bioaccumulative and carcinogenic. Phenol, pentachlorophenol, 2,3,4,6-tetrachlorophenol, 2,4,6-trichlorophenol, and 2,4-dichlorophenol are given highly toxic ratings in N. Irving Sax's Dangerous Properties of Industrial Materials. 2,4,6-Trichlorophenol has been identified by the Agency as a compound exhibiting substantial evidence of being carcinogenic. In addition, 2,4,6-trichorophenol has been reported to be mutagenic, and pentachlorophenol has shown mutagenic and teratogenic effects.

Many polynuclear aromatic hydrocarbons are known to be toxic, mutagenic, teratogenic and carcinogenic. Benz(a)-anthracene and chrysene have been identified by the Agency as compounds exhibiting substantial evidence of being

carcinogenic. Additional information and specific references on the adverse effects of the following substances can be found in Appendix A: These substances are also designated as priority pollutants under Section 307(a) of the Clean Water Act.

Pentachlorophenol	Creosote
Phenol	Chrysene
2-Chlorophenol	Naphthalene
p-Chloro-m-cresol	Fluoranthene
2,4-Dimethylphenol	Benzo[b]fluoranthene
2,4-Dinitrophenol	Benzo[a]pyrene
Trichlorophenols	Indeno[1,2,3-cd]pyrene
Tetrachlorophenols	Benz[a]anthracene
2,4-Dinitrophenol	Dibenz[a]anthracene
	Acenaphthalene

B. Migratory Potential of Hazardous Constituents

In light of the extreme danger posed by these waste constituents, the Agency would require some assurance that these waste constituents will not migrate and persist to warrant a decision not to list these waste streams. No such assurance appears readily available.

Many of these waste constituents, in fact, have proven capable of migration, mobility and persistence. Chrysene, naphthalene, benz(a)anthracene, and other polynuclear aromatic hydrocarbons have been detected in rivers, demonstrating ability to persist.(20) The migratory potential and persistence of phenol, trichlorophenol and dichlorophenol is confirmed by the fact that these constituents have been identified in samples taken at the Love Canal site in Niagara, Falls, New York.(28) Dichlorophenol has also been found in

school and basement air at Love Canal, demonstrating ability to migrate and persist in the air (See "Love Canal, Public Health Bomb, a Special Report to the Governor and Legislature", New York State Department of Health,1978.)

The American Wood Preservers Association examined the leaching in soil of pentachlorophenol at concentrations that would approximate conditions of treated wood in contact with the ground.(4,12) Soils containing 100 and 300 ppm pentachlorophenol resulted in a leachate containing less than 0.01 percent of the original concentration of the pentachlorophenol in the soil. However, the concentration levels in these studies were less than those which have been found in some wood preserving plant wastes. Additionally, the binding ability of soil with phenols may be much greater than that of biological treatment or other residue sludges. Thus, the predictive ability of an experiment showing a small amount of leaching for pentachlorophenol contaminated soils may not be applicable to treatment plant sludges. That pentachlorophenol will leach and migrate in actual mismanagement cases is in any event demonstrated by the damage incidents described below.

Creosote compounds have also demonstrated the ability for mobility and persistence. An actual damage incident of surface and groundwater contamination due to improper management of wood preserving chemicals, including creosote and pentachlorophenol, confirms the migratory potential, mobility

and persistence of the waste constituents in these wastes. In the 1950's, waste chemicals including creosote and other types of wood preserving chemicals were injected into wells in Delaware County, Pennsylvania. The injected wastes migrated into groundwater, infiltrated a storm drain sewer, and discharged into a small stream, causing biological damage. Although injection of the wastes into the wells ceased in the 1950's, contamination was first observed in 1961.(21) Thus, the waste constituents proved capable of migration via both ground and surface waters, and were able to persist and cause damage for long periods of time.

Two other mismanagement incidents demonstrate both the potential for migration and persistence of wood preserving plant wastes. In one incident, creosote was found to migrate from wood preserving treatment into the groundwater supply of a neighboring community (29). A very recent incident (September 14, 1980) of groundwater contamination by pentachlorophenol from a wood preserving plant occurred in Jacksonville, Florida. This sludge dump on the company property was allegedly responsible for contamination levels of pentachlorophenol in adjacent residential property groundwater at levels as high as 0.50 ppm. Drinking water was so far not found to be contaminated at an experimental detection limit of 12 ppm pentachlorophenol, but nitrophenol and 2-chlorophenol were detected though not quantified. Soil samples at one location adjacent to the facility contained up to 24 ppm pentachlorophenol.(30) These incidents demonstrate empirically that

these sludges, if mismanaged, may cause substantial harm to humans or other environmental receptors.

The mobility and persistence of polynuclear aromatic hydrocarbons also is shown by a number of damage incidents. Although these incidents do not involve the wood preserving industry, they do show that PAHs may migrate from creosote-containing wastes, and prove persistent upon release.

A company in Minnesota handled, stored, treated and disposed of coal tar, creosote oil and other products for over 50 years in an 80-acre site. While the operation supposedly included discharge of waste products into a ponding area, there were apparently numberous cases of spills, leaks, pipeline breaks, and burial of wastes over the years. As a result, chemicals associated with the company's process, among these polynuclear aromatic hydrocarbons, migrated as far as two miles. Five drinking water wells contaminated by the toxic wastes were closed in 1978 and 1979 after operations were stopped in 1971.(31)

A coke company in St. Paul used a 10'x13' unlined basin to dispose of oil, grease, various hydrocarbons and phenols. Inspection at the time of sale of this property revealed both soil and groundwater contamination with polynuclear aromatic hydrocarbons as far as 1400 feet from the pit.(31)

Another reason for thinking that the hazardous constituents in these wastes could prove sufficiently mobile to reach groundwater is the large quantities of waste generated. We believe the attenuative capacity of the environment surrounding

these facilities could be reduced or used up, since large quantities of bottom sediment sludge containing such large concentrations of harmful constituents are disposed of in landfills or sometimes allowed to accumulate at the bottom of ponds and lagoons for long periods of time.

Finally, many of the constituents of concern are highly bioaccumulative in environmental receptors. Benz(a)anthracene and pentachlorophenol are extremely bioaccumulative with octanol/water partition coefficients of 426,579 and 102,000, respectively. Tetrachlorophenol, trichlorophenol and dichlorophenol are also highly bioaccumulative with octanol/water parition coefficients of 12,589, 4,169 and 1,380, respectively (App. B).* Thus, the possibility that waste constituents could accumulate in harmful concentrations if they reach a receptor further supports a hazardous waste listing.

In light of the above damage incidents demonstrating migration and persistence and the extreme dangers to human health and the environment posed by these constituents, a failure to list this waste as hazardous is not justified.

C. Exposure Pathways

Mismanagement of these wastes, therefore, could lead to environmental contamination since constituents are available

*An octanol/water coeficient of 100 means that after an aqueous solution of the tet compound is intimately mixed with octanol and allowed to separate, there will be 100 times as much of the test compound in the octanol than in the water. Solubility of a substance in octanol models its solubility in body fat tissue and is, therefore, indicative of bioaccumulation potential.

for release and are likely to persist following release. Thus, as previously noted, the wastewaters generated by wood preserving operations are typically treated by evaporation, combined biological and irrigation process, or incineration. Bottom sediment sludge, generated by the treatment of the wastewater, is typically disposed of in an off-site landfill, after prolonged storage in holding lagoons. Incineration is another possible disposal method.

The treatment of wastewater in ponds and/or lagoons, if mismanaged, could lead to the release of hazardous constituents by leaching from the resulting sludges, particularly in light of these constituents' demonstrated propensity for migration. These waste constituents could thus contaminate groundwater if ponds or lagoons are unlined or lack adequate leachate collection systems. Siting of wastewater treatment facilites in areas with highly permeable soils could likewise facilitate leachate migration. The bottom sediment sludges, which form at the bottom of wastewater treatment ponds or lagoons, could thus release harmful constituents and contaminate groundwater. As previously noted, these sludges may be allowed to sit at the bottom of ponds for five years or longer[8,44], thus increasing the potential for release of harmful constituents and for eventual groundwater contamination.

There is also a danger of migration into and contamination of surface water if ponds and lagoons are improperly designed or managed. Thus, inadequate flood control measures could

result in washout or overflow of ponded wastes.

Disposal of bottom sediment sludge in off-site landfill, if mismanaged, could also lead to release of hazardous constituents. The waste constituents of concern may migrate from improperly designed or managed landfills and contaminate ground and surface waters.

Transportation of these sludges off-site increases the likelihood of mismanagment and of their causing harm to human health and the environment. Mismanagement of sludges during transportation thus may result in hazard to human and wildlife through direct exposure to harmful constituents. Furthermore, absent proper management safeguards, the waste might not reach the designated disposal destination at all.

The harmful constituents in the waste also present a health hazard via an air inhalation pathway. Studies on actual pentachlorophenol and creosote process wastewater samples using a laboratory scale pan evaporator indicated that a large percentage of the constituents of pentachlorophenol and creosote were entrained in the vapors after several hours of heating at temperatures up to 88°C.(18)

A letter from the manager of Kopper's Co., Inc. indicated that evaporation of pentachlorophenol effluent from a pan evaporator or cooling tower or other spray device could increase the amount of PCP discharged into the air and into the general environment. No supporting analytical data was provided (27). Thus, evaporation of wastewaters in ponds, lagoons, stripper/cooling towers, evaporation pans, and

incineration of wastewaters or sludges could lead to the release of hazardous and volatile constituents into the air.

Disposal of sludges by incineration is another type of management which could lead to substantial hazard. Improper incineration might result in serious air pollution by the release of toxic fumes occurring when incineration facilities are operated in such a way that combustion is incomplete. The formation of more toxic compounds such as polychlorinated dibenzo-p-dioxins or dibenzo-furans during the combusion of pentachlorophenol mixtures is also possible.[23,24,25] These conditions can, therefore, result in a significant opportunity for exposure of humans, wildlife and vegetation, in the vicinity of these operations, to potentially harmful substances.

References

1. Federal Register, Vol. 44, No. 212. Wednesday, October 31, 1979.

2. Development Document for Effluent Limitation. EPA: 440/1-74-023a.

3. Federal Register No. 202. Wednesday, October 18, 1978.

4. Ernst and Ernst. Wood Preservation Statistics. 1976. American Wood Preservers Association.

5. Not used in text

6. Myers, L.H., et al. Indicatory Fate Study. EPA: 660/2-78-175. August, 1979.

7. Handbook of Industrial Waste Compositions in California. 1978

8. Multimedia Pollution Assessment of the Wood Products Industries, Edward C. Jordan Co., Inc., for Industrial Pollution Control Division, EPA Contract No. 68-03-2605, November, 1979.

9. Hartford, W.H., "The Environmental Impact of Wood Preservation," American Wood Preservers Association, 1976. (Not cited in document)

10. Young, A.L. et al, Fate of 2,3,7,8-tetrachlorodibenzop-dioxin (TCDD) in the Environment: Summary and Decontamination Recommendations, United States Air Force Academy, Colorado, USAFA-TR-76-18, October, 1976. (Not cited in document)

11. Kirsch, E.J., and J.E. Etzel. Microbial Decomposition of Pentachlorophenol, Journal of Water Pollution Control Federation, Vol. 45, No. 2, February, 1973.

12. Arsenault, R.D., "Pentachlorophenol and Contained Chlorinated Dibenzodioxins in the Environment--A Study of Environmental Fate, Stability, and Significance when Used in Wood Preservation." American Wood Preservers Association, 1976.

13. Proceedings: Technology Transfer Seminar on the Timber Processing Industry--March 10,11, 1977. Toronto, Ontario. EPS: 3-WP-78-1, January, 1978.

14. Not used in text

15. Not used in text

16. Not used in text

17. Accurex Corporation, "Solid Waste from Wood Treating Processes - a Hazardous Waste Background Document", December 20, 1979.

18. Acurex Corporation, "Wood Treating Industry Multimedia Emission Inventory", Draft Report, June, 1980. EPA Contract 68-02-2611.

19. Development Document for Effluent Limitations, Guidelines and Standards for the Timber Products Processing Point Source Category. EPA 440/1-79/023b.

20. Shakleford and Keith, "Frequency of organic compounds identified in water," EPA-600/4-76-062, Environmental Research Laboratory, Athens, Ga., Dec. 1976.

21. U.S. EPA, Open File, unpublished data, Hazardous Site Control Branch, WH-545, 401 M St. S.W., Washington, D.C. 20460. Contact Hugh Kauffman 202/245-3051.

22. Harvey, W.A. and A.S. Crofts, "Toxicity of PCP and its sodium salt in three yolo soils." Hilgardia 21, 487 (1952).

23. Chem. Eng. News, Sept. 24, 1979, p. 27.

24. Rappe, C. and M. Stellan, "Formation of polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzofurans (PCDFs) by burning or heating chlorophenates" Chemosphere, No. 3, 269 (1978).

25. Jansson, B. and G. Sundstrom, "Formation of polychlorinated dibenzo-p-dioxins during combustion of chlorophenol formulations" Sci. Total Environ. 10, 209-217 (1978).

26. Office of Water & Waste Management, Effluent Guidelines Division, U.S. EPA, Unpublished data from ESE, Inc.) Plant sampling reports. 1979-1980. NOTE: This data may be used to indicate relative amounts of constituents only.

27. Arenault, R.D., Private communication to D. Costle, Administrator, U.S. EPA (February 13, 1980).

28. N.Y. State Department of Health, 1978. "Love Canal, public health bomb, a special report to the governor and legislature" (1978).

29. Mittelman, A. (1978) "Exposure analysis for creosote, coal tar and coal tar neutral oils, Unpublished Data. Office of Pesticides & Toxic Substances, U.S. EPA.

30. Private Communication, Vincent Cassidy, Water Pollution Control, Department of Health, Welfare and Biological Environmental Services, City of Jacksonville, Florida, October 15, 1980.

31a. U.S. EPA, "Damages and threats caused by hazardous material sites", EPA/430/9-80/004, p. 20. Jan. 1980.

31b. U.S. EPA, Suit against Reilly Tar, St. Louis Park, Minn., Filed Sept. 4, 1980 in District Court, Minneapolis, Minn.

32. Not used in text

33. Industrial and Environmental Research Laboratory, Food and Wood Products Branch. Contract No. 68-03-2605. "Evaluation of the batch treatment of industrial phenolic wastes." Unpublished data. Progress Report No. 5(12) of E. C. Jordon Co., 1979.

34. Office of Water Regulations & Standards, (1980) EPA. Ambient Water Quality Criteria, _____FR_____ (November_____,1980). *Note: No Federal REgister Citation is yet availalble, but the the Water Quality Criteria have been signed by the Administrator at the time of preparation of this document.

35. Environmental Health Advisory Committee, Science Advisory Board, U.S. EPA. Report of the Ad Hoc Study Group on Pentachlorophenol Contaminants. Draft Report, December, 1978.

36. Nestler, F.H.M. The characterization of wood preserving creosote by physical and chemical methods of analysis. Proposed USDA Forest Service Reseach Paper FPL 195. Preliminary copy. 1974.

37. Kirk Othmer Encyclopedia of Chemical Technology, 3rd Ed., Vol. 6, p 302, 1973.

38. Guerin, M.R. Energy sources of polycylic aromatic hydrocarbons. Oak Ridge National Laboratory. 1977.

39. 43 FR 48154, 1978.

40. Office of Solid Waste, U.S. EPA. Listing background documents for Creosote, Health & Environmental Effects. Appendix A May 19, 1980.

41. Dunn, B.P. & J Fee. Polycyclic aromatic hydrocarbon carcinogens in commercial seafoods. J. Fish Res. Board Can. 36, 1469, 1979.

42. Office of Toxic Substances, U.S. EPA. Investigation of selected potential environmental contaminants: Asphalt and coal for pitch Final Report. EPA-560/2-77-005, 1978.

43. U.S. Dept. of Agriculture, State's EPA Preservative Chemical Assessment Team. The biological and economic assessment of pentachlorophenol, inorganic arsenic, and creosote. Draft, May 15, 1980.

44. American Wood Preservers Institute. Comments submitted to the Office of Solid Waste, U.S. EPA, September 19, 1980.

Response to Comments - Wood Preserving Industry

One commenter raised a number of questions with respect to the hazardousness of waste K001 (Bottom sediment sludge from the treatment of wastewaters from wood preserving processes that use creosote and/or pentachlorophenol) and the proposed listing (wastewater from wood preserving processes that use creosote or pentachlorophenol).

1. The commenter first states that RCRA was not intended to cover the treatment and disposal activities of such facilities (i.e., at wood preservers), but rather was designed to eliminate abuses in waste treatment and disposal such as at Love Canal. The commenter then argues that these wastes are already adequately regulated under the Clean Water Act (CWA) and that the listing of wastewaters resulting from wood preserving and the sludge generated when the wastewater is treated will result in an expensive burden to the wood preserving industry without any commensurate public benefit.

   The Agency strongly disagrees with the commenter's claims. The Resource Conservation and Recovery Act was enacted by Congress to control the improper management of hazardous wastes. Although the Act has several objectives

(including the promotion of resource recovery and the proper management of non-hazardous solid waste), Congress' overriding concern in enacting RCRA was to establish a national system which would ensure the proper management of hazardous waste. Nowhere in the Act or in the legislative history does Congress make a distinction between the types of treatment, storage or disposal facilities the Act was meant to control. In fact, the Act is quite clear as to the extent of coverage; all wastes identified or listed by EPA as hazardous will be subject to the Federal "cradle-to-grave" management system for hazardous wastes. Therefore, hazardous waste treatment, storage and disposal facilities at wood preserving plants clearly may be subject to the requirements of RCRA.

The Agency also disagrees with the commenter's claim that these wastes, if managed in conformity with current effluent regulations, present no serious threat to human health and the environment. First, the comment is not even relevant to the listing of bottom sediment sludges. With regard to the proposed listing of process wastewater, it should be pointed out that under the CWA the Agency's authority is limited to the actual point source discharge into navigable waters, and not to the

industrial wastewaters upstream from the point of discharge. Environmental hazards posed by wastewaters in treatment and holding facilities--primarily groundwater contamination and the vaporization of volatile organic materials--therefore is not controlled under the CWA or other environmental statutes (See the Part 261 preamble for more detailed discussion of regulatory authority of wastewaters 45 FR at 3309 (May 19, 1980)).

Secondly, the fact that waste effluent is treated prior to point source discharge does not guarantee that human health and the environment is protected adequately during the treatment process. EPA believes that there is in fact a strong potential for hazardous volatile emissions from certain wastewater treatment processes using heat (i.e., pan evaporation or thermal ponds), which are currently used by the wood preserving industry. For example, in a laboratory pan evaporator test*, pentachlorophenol was detected and quantitatively recovered from the vapor phase. In this test, large percentages of the original pentachlorophenol in the wastewater was recovered in the volatile emissions after 3 to 4 hours of heating at temperatures up to 88.2°C.

* Accurex Report, 1980.

Emissions of naphthalene, acenaphthene, fluorene and phenanthrene/anthracene --all hazardous constituents--also were found from creosote wastewater pan evaporator tests.* Additionally, in a letter from the manager of Kopper's Co., Inc.**, it was indicated that evaporation of pentachlorophenol effluent from a pan evaporator, cooling tower, or other spray device would increase the amount of pentachlorophenol discharged into the air and into the general environment.

Furthermore, incineration is also used by the wood preserving industry as a method for managing wastewater (although the Agency does not currently know to what extent). Disposal by incineration, if mismanaged, could result in the release of toxic fumes when incineration facilities are operated in such a way that combustion is incomplete (i.e., the formation of toxic compounds such as polychlorinated dibenzo-p-dioxins and dibenzofurans during

*The normal volatility of pentachlorophenol and of the components of creosote and pentachlorophenol would be greatly increased by the common phenomenon of co-distillation, or the additive vapor pressures of the components of the two phase oil/water system. (see WJ Moore, Physical Chemistry, or any similar undergraduate chemistry text.) Therefore, the Agency cannot accept data on the volatilization temperature of individual components of creosote and pentachlorophenol as predicting the volatilization temperature during a steam distillisation process, as exists during pan evaporation.

**Arenault, R.D., Feb. 13, 1980, Private communication to D. Costle, Administrator, U.S. EPA.

the combustion of pentachlorophenol mixtures, as well as volatilizing of pentachlorophenol and creosote*). Therefore, the Agency strongly believes that mismanagement of these wastewaters could lead to a large amount of pentachlorophenol, creosote components and other volatile organics volatilizing into the atmosphere creating a substantial present or potential hazard to human health and the environment. Assertion of RCRA jurisdiction provides a logical means of dealing with this potential problem.

Finally, with respect to the commenter's concern as to the economic impact these regulations will have on the wood preserving industry, the Agency has reviewed carefully the legislative history of RCRA and finds no indication that Congress intended adverse economic impact to be considered in implementing Subtitle C of RCRA. Nor is there any explicit requirement in the Act directing EPA to consider costs in the development of its regulations, as appear in other environmental statutes. Rather,

*Chemical Engineering News, Sept. 24, 1979, p. 27; Jansson, B. and G. Sundstrom, 1978, "Formation of Polychlorinated Dibenzo-p-dioxins During Combustion of Chlorophenol Formulations", Science Total Environment, 10, 209-217; Rappe, C. and M. Stellan, 1978 "Formation of Polychlorinated Dibenzo-p-dioxins (PCDDs) and Dibenzofurans (PCDFs) by Burning or Heating Chlorophenates", Chemosphere, No. 3, p. 269.

the Agency is directed to protect human health and the environment. This being the case, we do not believe consideration of economic impact to be relevant in making hazardous waste listing determinations.

2. The commenter then argued that the overwhelming majority of data contained in the listing background document on wood preserving pertains only to wastewater treatment sludge, and not to wastewater itself. In fact, the commenter points out that only Table 5 on pg. 155 (May 19, 1980 listing background document) contains any indication that the hazardous constituents may be present in wood treating wastewater, and even this table fails to give any indication of the concentrations of those substances. Therefore, the commenter argues that this limited information in no way justifies the summary conclusion that wood treating wastewater will contain "significant" concentrations of either "toxic phenolic compounds and volatile organic solvents such as benzene", or "toxic polynuclear aromatic components of creosote and volatile organic solvents such as toluene." Thus, the commenter believes the Agency has failed to establish any factual predicate for listing wood preserving wastewater as hazardous.

The Agency agrees with the commenter that the listing background document on wood preserving

contained only limited data on the composition and concentrations of the toxic constituents present in the wastewater. However, the Agency also believes that sufficient information was available in the record (which the commenter has been known to review) to support the listing of this waste stream. For example, in the draft report, "Wood Treating Industry Multimedia Emission Inventory", prepared by the Acurex Corp., June 1980 (cited by the commenter), analysis of wastewaters from both the steam and boulton conditioning processes shows levels of phenolic compounds and polynuclear aromatic compounds in a number of the samples which are many times higher than the ambient water quality criteria standards. The listing background document has been amended by adding new data giving untreated wastewater pollutant concentrations and the levels of these pollutants in ambient water which may adversely affect aquatic life and human health. (Reference Nos. 18,19,34). We also have reopened the comment period to receive additional comment on this new data. Additionally, if wood preserving plant wastewater did not typically contain significant levels of a number of toxic contaminants, then effluent limitations would not have been placed on this industry under the Clean Water Act.

3. The commenter also objected to the Agency's conclusion that these wastes are uniform throughout the country. The commenter believes that EPA has failed to take into account the various technologies and treatment methods used which would lead to variations in the concentration of the toxic constituents in the wastes. For example, the commenter indicated that sludges generated by evaporation wastewater disposal mechanisms such as cooling towers will contain relatively high concentrations of pentachlorophenol and certain other substances, whereas bottom sediment sludges from biological wastewater treatment lagoons generally contain markedly lower concentrations of pentachlorophenol. The same lack of uniformity also applies to wastewater because of the variations in preservation technologies and wastewater treatment technologies. For example, the commenter indicated that the concentration of pentachlorophenol in wastewater generated in the steam conditioning process, for instance, typically range from 1.2 mg/l to 306 mg/l.* Therefore, the commenter believes that due to the wide range in the concentrations of the hazardous constituents,

* Wood Treating Industry Multimedia Emission Inventory, Corp., June 1980.

wood preserving wastewaters and sludges do not exhibit sufficient uniformity to be listed as hazardous wastes.*

In responding to this comment, the Agency emphasizes that listing of wood preserving wastewater treatment sludges and wastewaters is justified even if these waste streams have widely varying compositions, provided that wastes meeting this description typically or frequently are hazardous. More extensive review of the concentration levels of the constituents of concern have been included in the revised listing background document. These are contrasted with the concentration levels found to adversely affect aquatic organisms or human health which have been set as ambient water quality criteria levels found in Table 10 of the listing background document (these ambient water quality criteria have recently been signed by the Administrator and are now awaiting Federal Register publication). In all cases, the wastes contained several of the

*The commenter also included data in their comments taken from EPA's Background Document for Effluent Limitations, Guidelines and Standards for Timber Products Processing (October 1979) which indicates the concentration of the toxic contaminants in the wastewater to be low. However, this data represents the concentration of these contaminants in the treated effluent wastewater. The Agency believes that this data is inappropriate on which to make a decision on the hazardousness of untreated wastewater.

constituents of concern at concentration levels many orders of magnitude greater than those in Table 10. For example, compare the commenter's low range concentration of 1.2 mg/l pentachlorophenol in untreated wastewater with the concentration of 3.2 ug/l (0.0032 mg/l) which has been found to be acutely or chronically toxic to some freshwater aquatic species. A hypothetical waste concentration of 1 mg/l polynuclear aromatic hydrocarbons should be compared to the ambient water quality criteria of 2.8 ng/l (0.0000028 mg/l) necessary to prevent a human cancer risk of one in 10^6.

Under certain conditions, a concentration of a substance in a waste stream which is greater than the ambient water quality criteria may not present a threat to the environment or to human health. An effluent containing 1 mg/l polynuclear aromatic hydrocarbons could be released to certain remote navigable waters where no significant exposure to humans or aquatic life results. Alternatively, this same waste could potentially be managed in such a way as to significantly affect the quality of the environment and human health by, for example, drinking water contamination on adjacent residential property. We believe the <u>potential</u> causing substantial hazard

is evident, and that hazardous waste regulation therefore is appropriate.

Therefore, the Agency will continue to list these wastes as hazardous because of their extreme toxicities. The Agency believes that the burden should be on the generator to show that their waste is non-hazardous through the de-listing process (§§260.20 and 260.22).

4. The commenter then requested that if the Agency decides to list the wastewater and sludge as hazardous, a minimum cut-off level below which the waste would be considered non-hazardous should be set. The commenter argued that this approach is consistent with the factors for listing wastes as hazardous which are enumerated in Section 261.11(a)(3) and would provide for a more rational basis for regulating the industry. Additionally, the commenter felt that setting a minimum concentration would provide owners and operators of covered facilities with a fixed yardstick to determine whether they produce hazardous wastes and provide significant incentives to fall below the threshold level. As a suggestion, the commenter recommended that the Agency adopt the present effluent limitations of 100 mg/l oil and grease for wood treating wastewater since

EPA's Effluent Guidelines Division has reported that if oil and grease, as measured by Standard Methods is 100 mg/l or less, then pentachlorophenol and total polynuclear aromatic hydrocarbon concentrations are usually below 15 mg/l and 1 mg/l, respectively.

The Agency agrees with the commenter that setting a minimum cut-off level below which the waste would be considered non-hazardous is desirable; however, the Agency has been unable to do this since no chronic exposure threshold levels, except for those toxic contaminants specified in the National Interim Primary Drinking Water Standards (NIPDWS), relating to drinking water have been established. Additionally, the Agency is concerned with the possibility of volatile emissions from the wastes but again no chronic exposure threshhold levels relating to air emission standards have been established. Therefore, the Agency will not set a minimum cut-off level for these wastes, but rather will continue to evaluate the hazardousness of these wastes after considering the factors specified in §261.11(a)(3).

We also note that effluent discharge levels established by the Effluent Guidelines Division

are not necessarily appropriate in evaluating whether a waste is hazardous, since the effluent limitation level is based on the pollutant reduction achieved by Best Available Technology, which standard not only is technology-based, but takes economic considerations into account. The RCRA standard, "may pose a substantial present or potential hazard to human health or the environment when improperly managed" (§1104(5)(B)), is much broader since it is neither technology based, nor are economic considerrations relevant. We therefore do not accept the argument that effluent guideline indicator limitation levels should be used to gauge a waste's potential to cause substantial harm if mismanaged.

5. The commenter also indicated that a number of fundamental mistakes were made by the Agency in characterizing these wastes. For example, both benzene and toluene are cited as present in both the wastewater and sludge. With respect to wastewater, the commenter indicates that these constituents are likely to be found only in treating plants which utilize vapor drying, and thus cannot be considered as typical of the industry's wastes. Further, the commenter points out that these substances are likely to be present in only minute quantities.

Moreover, the listing background document contains no evidence that either benzene or toluene are ever present in wood treating wastewater sludge. However, the commenter points out that both benzene and toluene are listed as constituents of concern for the wastewater treatment sludge.

In re-assessing the data, the Agency agrees with the commenter and has revised the listing background document to reflect these changes. Additionally, benzene and toluene have been removed as constituents of concern for both the wastewater and bottom sediment sludges.

6. The commenter also felt that data taken from the California state hazardous waste manifests (i.e., concentration data of pentachlorophenol (5-20%) in the bottom sediment sludge) was inaccurate and refers not to the concentration of pentachlorophenol in the sludge, but rather to the concentration of pentachlorophenol in the original treatment solution. Therefore, the commenter requested that EPA re-examine the accuracy of this data.

In contacting Dr. David Storm of the Department of Health, State of California, the Agency has confirmed the accuracy of this data. We thus will continue to include this data in the listing background document to support the listing of the bottom sediment sludge.

7. The commenter then argued that the listing background document was incorrect in its statement that bottom sediment sludge may accumulate in wastewater treatment ponds for about five years prior to removal (B.D., pp. 153 and 164). The commenter pointed out that sludge from biologically active lagoons may never be removed.

The Agency has amended the listing background document to include this information.

8. The commenter then felt that EPA had severely mischaracterized the biodegradability of pentachlorophenol, i.e., the commenter believes that pentachlorophenol is "readily biodegradable."

The Agency disagrees with the commenter's claim. In data submitted by the commenter, pentachlorophenol in concentrations of 200 ppm or less did not degrade for 205 days. The Agency believes that this period of time is not insignificant, and in fact, is concerned that pentachlorophenol will volatilize into the atmosphere or migrate into groundwater over this time period and will create a substantial hazard to human health and the environment, especially due to the toxicity of pentachlorophenol. The Agency also believes that because of the higher concentrations of pentachlorophenol found in some wood preserving sludges, the biodegradability

of this compound would be less, as discussed in the listing background document. Additionally, pentachlorophenol has been found to persist in warm moist soils for a period of 12 months,* and also has been detected in human and animal tissues showing that pentachlorophenol in its present ambient environmental concentrations does not degrade readily enough to prevent detectable levels in human and animal tissues.**

The American Wood Preservers Institute itself has acknowledged the difficulty of biodegradation of sludge containing greater concentrations of pentachlorophenol by the following statement:

> "While the activated sludge in POTWs has the capacity to biodegrade penta[-chlorophenol], sludge from evaporative disposal mechanisms generally contain high concentrations of wood preserving materials and consequently will not biodegrade unless diluted."***

Finally, actual damage incidents have demonstrated the ability of pentachlorophenol and

---

*Harvey, W.A. and A.S. Crafts, 1952, "Toxicity of PCP and its Sodium Salt in Three Yolo Soils", Hilgardia 21, 487.

**U.S. EPA, Office of Drinking Water, 1980, Pentachlorophenol Ambient Water Criteria Document.

***AWPI, Comments on Timber Products Processing Point Source Category, Feb. 15, 1980.

creosote to persist in the environment for several years. These incidents show empirically that pentachlorophenol can persist in concentrations sufficient to cause substantial harm if mismanaged.

Therefore, the Agency does not consider pentachlorophenol "readily biodegradable" and will continue to include pentachlorophenol as a constituent of concern in the listing of these wastes.

9. The commenter then argued that there is no evidence that tetrachlorodibenzoparadioxin (TCDD) is present as a constituent of wood treating wastewater or bottom sediment sludge as indicated in the listing background document (footnote no. 2, pg. 155).

In re-evaluating the available data, the Agency agrees with the commenter that current data does not indicate the presence of tetrachlorodibenzoparadioxin in the listed wastes except where these wastes are incinerated, since polychlorinated dibenzo-p-dioxins are formed during the incomplete combustion of pentachlorophenol mixtures. Therefore, the listing background document has been modified to reflect this change. Other chlorinated dioxins have been found in commercial pentachlorophenol (Table 4) and could therefore be expected to be present in very small amounts in some wastes.

10. The commenter also argued that EPA's bibliography

is incomplete and often contains only one side of the story on many issues relating to wood preserving. For example, the commenter pointed out that references 15 and 16 are alarmist articles concerning suspected diverse health effects from penta-treated wood while the final report "Miami Epidemiologic Studies Program,"* which found no correlation with any regulatory used wood preserving chemical and no connection whatsoever with wood treating wastes, was not cited in the listing background document. Additionally, the commenter pointed out that several of the studies relied upon by EPA contain inaccuracies which have not yet been corrected although the Agency has been made aware of these problems.

In preparing the listing background document, the Agency has relied for the most part on data/reports that were available to the Agency. There may have been some studies the Agency was unaware of which were not included in the listing background document. The Agency agrees with the commenter that as much data as possible should be considered

*Aldrich, T.E. and R.C. Duncan, "Investigation of Citizen Reported Increase of Cancer Mortality and Morbidity in Madison County, Kentucky in Relation to Pentachlorophenol Exposure," October 24, 1979.

in making a determination on the hazardousness of the waste. Therefore, the Agency has modified the bibliography and will include other studies that are pertinent, including the Miami Epidemiologic Studies Program cited by the commenter.

The Agency would like, however, to make a few comments with respect to this study. The commenter characterized the study as having found no correlation between exposure to regularly used wood preserving chemicals (i.e., pentachlorophenol) and chronic disease. While the Agency believes that this study may not provide the basis for proof of a correlation between exposure to wood treated with pentachlorophenol and chronic disease,* the Agency does believe it provides enough positive data to be provocative. For example, the study concluded that "[i]n any case, there would appear to be a suggestion of the need for the study of a possible risk between occupational exposure to pentachlorophenol treated materials and leukemia." Additionally, in the November 16, 1979, clarification memorandum included in this study, the statement is made by

*Some of the reasons the Agency believes this study does not provide the basis of proof include its limited scope, the inadequate time span allowed from exposure to observation of malignant disease, the possibility that the pentachlorophenol used at the time of exposure contained greater amount of contaminants, etc.

the researchers "[t]hat six (five depot employees and one community) cases from this category [chronic lymphocytic and chronic myelocytic leukemia] would have a common association to pentachlorophenol is remarkable." Therefore, the Agency believes that this study in no way conflicts with the listing background document, or our decision to list pentachlorophenol as a waste constituent of concern.

With respect to the other studies the commenter cites which contain inaccuracies, the Office of Solid Waste has cited data only from those portions of the report which are accurate. Therefore, the Agency believes that it can continue to utilize this data. It should be noted, however, that the Agency expects to correct the inaccuracies in these reports as soon as possible.

11. The commenter also argued that the Agency has failed to cite a single incident of mismanagement of sludge from wood preserving wastewater treatment or wood preserving wastewater which has resulted in any sort of environmental problem. The commenter pointed out that although this criterion is listed as relevant to a hazardous waste listing in §261.11(a)(3)(ix), the absence of any such problems over the history of the wood treating industry does not appear to have received

any attention from EPA. Therefore, the commenter believes that the Agency has failed to adequately assess either the potential for harm from wood preserving wastes or any actual harm which has resulted from sludges from treatment of wood preserving wastewater or the wastewater itself.

The commenter misperceives the regulatory mechanism adopted by the Agency for identifying hazardous waste through the listing process. The factors listed in §261.11(a)(3) need not all be present for a waste to be listed as hazardous. While this factor is relevant in making listing determinations, a waste need not actually have been mismanaged for it to be considered hazardous. In fact, the definition of hazardous waste cited in the Act supports this interpretation, since a a waste is hazardous if it "may pose a substantial hazard. . .if improperly managed. . ." Congress thus clearly indicated that damage did not have to be demonstrated before designating a waste as hazardous. If this interpretation was not taken only those wastes which have caused environmental insult could be designated as hazardous. The entire rationale for enacting RCRA, to prevent the mismanagement of hazardous waste and the resulting potential for creating substantial harm to human

health and the environment, would be undermined. Therefore, the Agency believes that actual damage does not have to be demonstrated, but only to show that the waste, if improperly managed, may pose a substantial hazard to human health and the environment which the Agency believes it has done for the two wastes generated from the wood preserving industry.

In any case, we have considered whether these wastes have been involved in damage incidents, and, as shown in the listing background document, mismanagement and actual damage have indeed occurred. We believe these incidents show empirically that these wastes are capable of posing substantial hazard if mismanaged and thus warrant listing.

12. The commenter argued that the Office of Solid Waste has failed to coordinate and take into account the actions of other branches of EPA (i.e., Effluent Guidelines Division and the Special Pesticide Review Division, etc.) with respect to the wood treating industry. More specifically, the commenter believes that the hazardous waste regulations have the potential to overlap or conflict with programs under the Clean Air Act, the Clean Water Act (i.e., regulations to be promulgated on effluent limitations applicable to the wood treating industry) and the Federal

Insecticide, Fungicide and Rodenticide Act (i.e., the RPARs the Agency is currently considering against the three wood preservative chemicals, pentachlorophenol, creosote and the inorganic arsenicals). Therefore, the commenter believes that any regulations promulgated under RCRA must be coordinated with other parts of the Agency to avoid confusion in the regulated community caused by conflicting and environmental programs.

In preparing the listing background document on the wood treating industry (May 2, 1980), the Agency had discussed the various aspects of these listings--wastewater and bottom sediment sludge from the wood treating industry--with other offices within the Agency before promulgating these regulations. Therefore, the Agency did attempt to avoid any internal inconsistencies. However, to ensure that any inconsistencies that still remain are either straightened out or fully explained, the Office of Solid Waste has discussed these listings, along with the comments received by the American Wood Preservers Institute (AWPI), with both the Effuent Guidelines Division and the Special Pesticide Review Division. It should be noted, however, that part of the confusion expressed by the commenter may be due to their misunderstanding of the authorities

and objectives on the various pieces of environmental legislation (e.g., see response to comments nos. 1 and 16 in this background document).

13. The commenter then argued that the quantities of waste generated from wood preserving are not large, and thus do not pose the degree of risk which would warrant subjecting the industry to the burdensome reporting, monitoring, recordkeeping, financial and insurance requirements under Parts 264 and 265. Additionally, the commenter argued that wood preservers do not actually accumulate significant amounts of hazardous waste on-site since their treatment processes renders the waste materials innocuous.

The Agency disagrees with the commenter. Data presented in the listing background document indicates that approximately 200 million gallons of wastewater are generated annually of which approximately 90 percent is treated to generate bottom sediment sludge. Additionally, data provided by the American Wood Preserver's Association indicates generation of total process solid wastes of between 830 to 1530 metric tons/yr, which in the Agency's opinion is a significant quantity of waste, especially in light of the extreme toxicities of the constituents of concern in these particular wastes. Therefore,

the Agency believes that these wastes are generated in sufficient quantity and do pose a risk substantial enough to warrant control under the hazardous waste management control system.

With respect to the commenter's claim that the treatment processes render the waste materials innocuous, the Agency would like to make two points. First, the Act requires that any process which treats a hazardous waste requires a permit under RCRA, thus is subject to control under Subtitle C of RCRA. Second, the Agency believes that insufficient data has been submitted by the commenter to substantiate their claim that these treatment processes render the waste materials (i.e., bottom sediment sludge) innocuous. In this regard, we note that the commenters supplied almost no waste analytic data with their comments, even though the wastes were originally proposed for listing in August, 1979, and even though the July 1980 comment period for comment to the May interim final listing was effectively extended to allow this industry time to gather and present such data. (Industry comments have, however, been helpful and informative in other respects.) Third, information available to the Agency indicates that currently practiced wastewater treatment processes (e.g., cooling/

stripping towers) generate sludges which in the Agency's opinion are not innocuous after consideration of the concentrations of wood preserving oil residues. Indeed, even biological treatment sludges from final retention ponds appear to contain relatively high concentrations of particular waste constituents (see Table 7 to the listing background document).

14. Another commenter argued that three chemicals mentioned in the listing background document (benz[a]anthracene, benzo[b]fluoranthene, and benzo(a)pyrene) are not commonly constituents of "modern" creosote. The commenter further argued that reported adverse effects may have only been caused by certain creosote oils, e.g., those containing benzo[a]pyrene.

The Agency accepts the evaluation conducted by the Carcinogen Assessment Group that creosote itself has substantial evidence of carcinogenicity, and that this propensity derives in part from constituents other than benzo[a]pyrene. Another component of creosote, chrysene, is present in larger quantities (and was listed by the commenter as a constituent even of "modern" creosote) than the three components mentioned by the commenter, and has also been evaluated by EPA's Carcinogen Assessment Group as having substantial evidence of carcinogenicity.

Thus, even if the commenter is correct, we would not alter the waste listing.

But in any case, there is evidence that these compounds are indeed components of creosote. Furthermore, benzo[a]pyrene has been found to be present in creosote by sources other than the commenter.* It and the other components questioned by the commenter also have been found in both wastewater and bottom sediment sludges from wood preserving plants(18) and has been detected in elevated levels in mussels growing near creosote treated timber pilings (39,40) and in the edible meat of lobsters maintained in commercial tidal compounds constructed of creosote treated timber. (40,41). We thus believe these substances are ordinarily found in creosote and can escape into the environment to cause substantial harm. Therefore, the Agency will continue to include these substances as a basis for listing creosote-containing waste-water and bottom sediment sludges from the wood preserving industry.

15. The commenter argued that pentachlorophenol does not meet RCRA's criteria for classification as an acutely hazardous waste under section 261.11(a)(2),

*Guerin, 1977 "Energy Sources of Polycylic Aromatic Hydrocarbons." Oak Ridge National Laboratory.

and submitted unpublished studies showing that pentachlorophenol had acute toxicity ranges outside of the criteria limits set in section 261.11(a)(2). The commenter asserted that the Department of Transportation (DOT), which uses the same criteria in making determinations of "Poison B" materials responded to the same studies by removing pentachlorophenol from its "Poison B list."*

First, the Department of Transportation did not consider the toxicity in its delisting of pentachlorophenol. The published rationale for the DOT decision** appears instead to consider only the fact that pentachlorophenol is a solid, instead of a liquid: "This entry is listed with quantity restrictions and packaging requirements for a liquid, yet the material is a solid. . ., it has therefore been deleted because of the uncertainty of entry description." The Agency is not able to acknowledge that the DOT either performed a toxicological validation of the submitted studies or delisted pentachlorophenol for reasons of its correct commercial form.

*We note in passing that this comment is actually addressed to the §261.33 regulation. However, since the comment was made in the course of comments on the wood preserving industry waste listing, and pentachlorophenol is of particular significance to this industry, we are responding to the comment here.

**41 FR 40618 (September 20, 1976).

The Office of Pesticides Programs has assisted the Office of Solid Waste by reviewing several published acute toxicity studies on pentachlorophenol. With this validation, the Agency is able to remove pentachlorophenol from the acutely hazardous list. The studies in question are summarized below.

One published study showing an oral lethal dose of 27 mg/kg was performed as a 0.5% solution of pentachlorophenol in fuel oil, and therefore was not found indicative of the toxicity of pentachlorophenol alone without contributon of toxicity from the vehicle. Besides this study, which was criticized by the commenter, the Agency is aware of two additional studies indicating the possibility of an LD_{50} value below 50 mg/kg. A recent experiment* resulted in an oral LD_{50} of 36 mg/kg for pentachlorophenol administered to C57 male mice in 40% ethanol. One report estimated the LD_{50} for humans to be as low as 29 mg/kg.** The Ahlborg study may also have had toxicity contribution from the vehicle. (This study would not have been available to the DOT for its 1976 decision.) The Dreisbach

*Ahlborg, U.G., and K. Larsson. "Metabolism of Tetrachlorophenols in the Rat." Arch. Toxicology, 40, 63 (1978).

**Dreisbach, R.H. Handbook of Poisoning, Diagnosis and Treatment, p. 256 (1963).

listing was found too general and without supporting data.

The two unpublished contract studies submitted to the Agency by the commenter were not subjected to validation, since published studies following technically more defensible protocol were available. For example, the material tested by both International BioReseach and Wil Research Laboratories for the commenter is described as "49-162 Pentachlorophenol from Reichhold Chemicals; small brown crystals with a pungent odor." There is no way for the Agency to determine if this substance is technical or purified grade, or if it resembles the commercial products of other companies such as Dow or Monsanto. No analyses of major impurities was given. The crystalline solid tested may have been a product of an isolation/purification synthesis step that never occurs in the preparation of concentrated solutions of pentachlorophenol for major industrial use (technical grade). Also, there exists an inconsistency between the two studies submitted by the commenter in its description of the administered dose. One study describes a 1.0% suspension of the pentachlorophenol in corn oil and the other describes a 50% solution of pentachlorophenol in corn oil. It is highly improbable that identical pentachlorophenol samples would not dissolve in low

concentrations in corn oil, but would dissolve in high concentrations.

16. Finally, the American Wood Preservers Institute has argued both in its comments and in other public forums that the Agency should not promulgate hazardous waste listings for this industry until the Rebuttable Presumption Against Registration (RPAR) process for pentachlorophenol and creosote is completed by the Agency's Office of Pesticide Programs. (The RPAR process is well underway, and is expected to be completed within the next six months.) Indeed, it is suggested that the Agency may be precluded legally from listing these wastes pending completion of RPAR review.

We disagree strongly. The RCRA hazardous waste listing process and the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) cancellation process have different objectives and are governed by different statutory standards. The FIFRA review process balances the environmental hazards with the benefits of use of a pesticide. Thus, under FIFRA, the key determination for registration or cancellation of a pesticide is whether use or continued use "generally causes an unreasonable adverse effect on the environment." (FIFRA Sections 3(d), 6(b).) An 'unreasonable adverse effect on

the environment' is defined as "any unreasonable risk to man or the environment, taking into account the economic, social, and environmental costs and benefits of the use of any pesticide."* Further, in determining whether to issue a notice of intent to cancel a registration, the Administrator must take into account the proposed action's impact on "production and prices of agricultural commodities, retail food prices, and otherwise on the agricultural economy." (FIFRA Section 6(b).)

No such balancing is involved in making hazardous waste listing determinations (or in identifying hazardous wastes by means of a characteristic) under RCRA. Wastes are to be regulated as hazardous if they are capable of posing a substantial threat to human health or the environment if managed improperly (RCRA Section 1004(5)). No weighing of benefits is mentioned in the statute, nor is such a consideration even germane, since the disposition of solid or hazardous wastes ordinarily has little if any social or economic benefit (see H.R. Rep. No. 94-1491, 94th Cong., 2d Sess. 4 (1976)).

*(FIFRA, Section 2(bb), emphasis supplied; see also 40 CFR §162.11(a)(5)(iii) (authorizing consideration in determining whether to cancel a pesticide use of evidence of whether the "economic, social and environmental benefits of the use of the pesticide subject to the presumption outweigh the risk of use.")

Identification and listing of hazardous wastes thus is a significantly different type of determination than RPAR review under FIFRA. Simply put, wastes from manufacture of registered pesticides may well be capable of posing a substantial threat to human health and the environment and thereby be listed as hazardous even if the social, economic and environmental benefits of use of the pesticide outweigh the respective risks and justify its continued registration. This being so, we believe it inadvisable to defer regulation of these wood preserving process wastes pending completion of RPAR review since neither determination controls the other. Indeed, under the integration provision of RCRA (Section 1006(b)), the Agency is to integrate its implementation of RCRA and other environmental statutes (including FIFRA) "only to the extent that it can be done in a manner consistent with the goals and policies expressed in (RCRA) and in the other acts. . ." As shown above, the RCRA listing process and the FIFRA RPAR review process have fundamentally different goals and policies, and fundamentally different substantive statutory standards. We therefore will proceed with our listings of these process wastes.

We note as a further , and central, reason for not deferring regulation that the RPAR process will not consider the composition of wood preserving manufacturing process wastes or their potential to cause substantial harm if mismanaged. These process wastes are not pesticides; nor are they registered for use. Their potential to cause substantial environmental harm if mismanaged is not at issue, or even relevant to the RPAR proceeding. We thus do not accept the advisability, even as a pragmatic matter of deferring RCRA regulation pending completion of RPAR review.